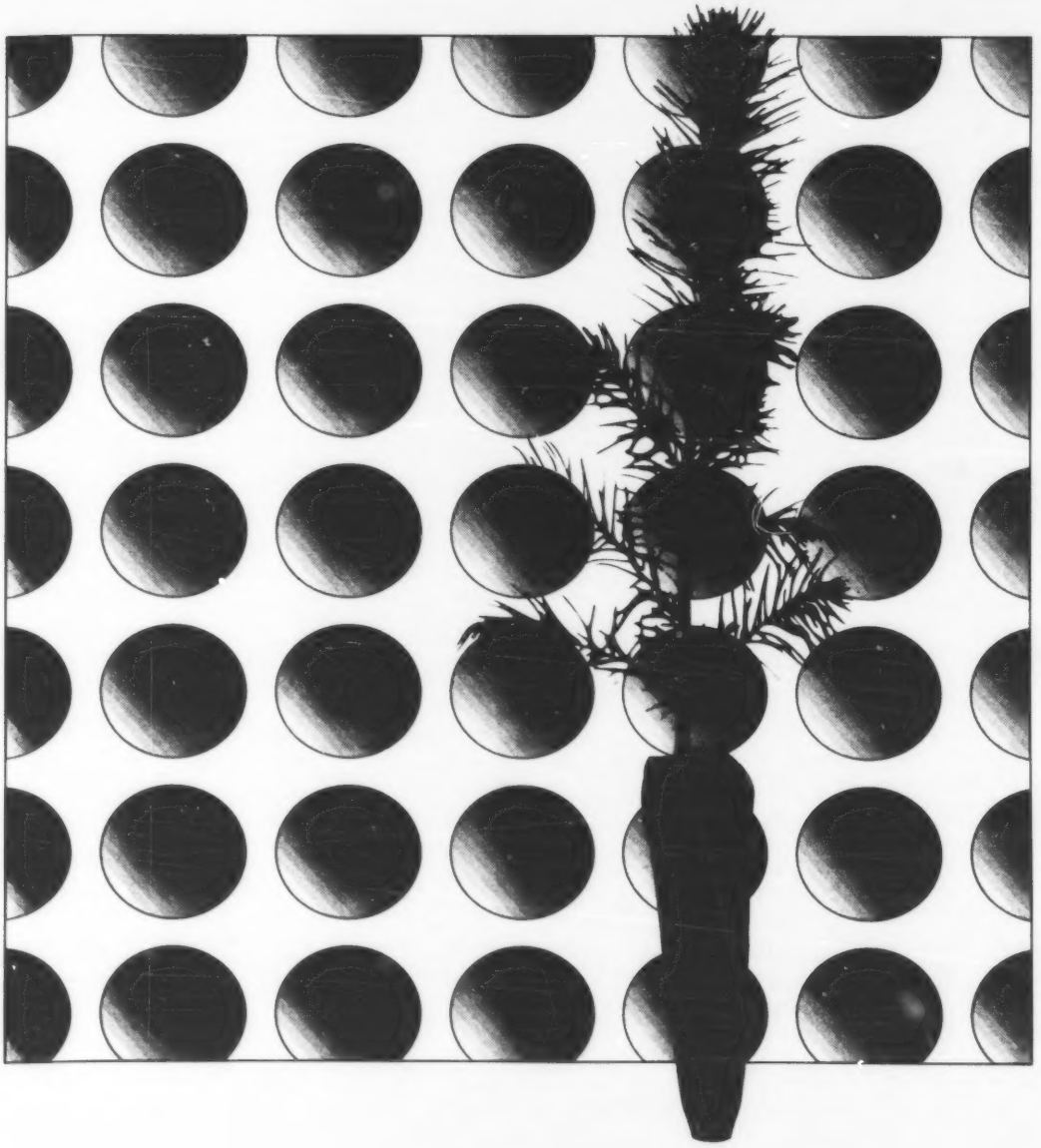
SILVICULTURE

Guidelines for the Sanitation of Nursery Seedling Containers



Province of
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Ministry
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Guidelines for the Sanitation of Nursery Seedling Containers

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Table of Contents

Introduction 5

Summary 6

Recommendations 7

Styroblock Sanitation Treatments 8

Overview 8

Heat Treatments 9

Steam 9

Hot Water 10

Heated Soaps 11

De-Moss 11

Ivory 11

Chemical Treatments 12

Bleach 12

Industrial bleach 12

Household bleach 12

Hydrogen Peroxide 14

Sodium Metabisulphite 15

For More Information 16

Introduction

In British Columbia, over 95 percent of all reforestation seedlings are grown in styrofoam containers (styroblocks). Repeated use of styroblocks, however, promotes the development of algae and root rot fungi which results in significant seedling losses every year. To address this problem, over 100 methods for sanitizing recycled styroblocks were examined and, based on these findings, recommendations for operational use were developed.

With the dominance of container seedling production and the prohibitive environmental and monetary costs of annually replacing styroblocks, the need arose for a comprehensive guide on styroblock sanitation. The following recommendations translate into direct savings to the nursery industry by increasing the lifespan of the styroblocks, augmenting seedling quality and reducing styrofoam waste.

Disclaimer

This guide is intended to acquaint the user with some of the available methods for sanitizing styroblock containers used to grow forest seedlings. A number of methods have been selected for discussion, based on findings concerning their ease of application and their ability to reduce the fungi and algae which build-up on styroblock containers. However, neither the Province of British Columbia, the author, nor any person who assisted in the preparation of this guide, warrants the effectiveness of any of the methods discussed.

These methods may involve risks to people, equipment and machinery, the environment, or seedlings subsequently grown in treated containers. This guide is not intended to deal comprehensively with safety or environmental issues. The mention of safety concerns should not be taken to mean that there are no other safety concerns. Nor should mention of specific concerns relating to the disposal of soaps, bleaches, chemicals or other substances be taken to mean that there are no other environmental concerns.

Users of this Guide should familiarize themselves with the Workers' Compensation Board regulations, the *Waste Management Act* and the *Canadian Environmental Protection Act*. Other provincial or federal statutes or regulations may apply to specific situations.

Where this guide refers to a particular brand name product, or to a manufacturer's recommendations regarding the preparation or use of a product, reference should always be made to the manufacturer as to the suitability of a particular product for a particular problem, and as to whether or not there are more recent manufacturer's guidelines.

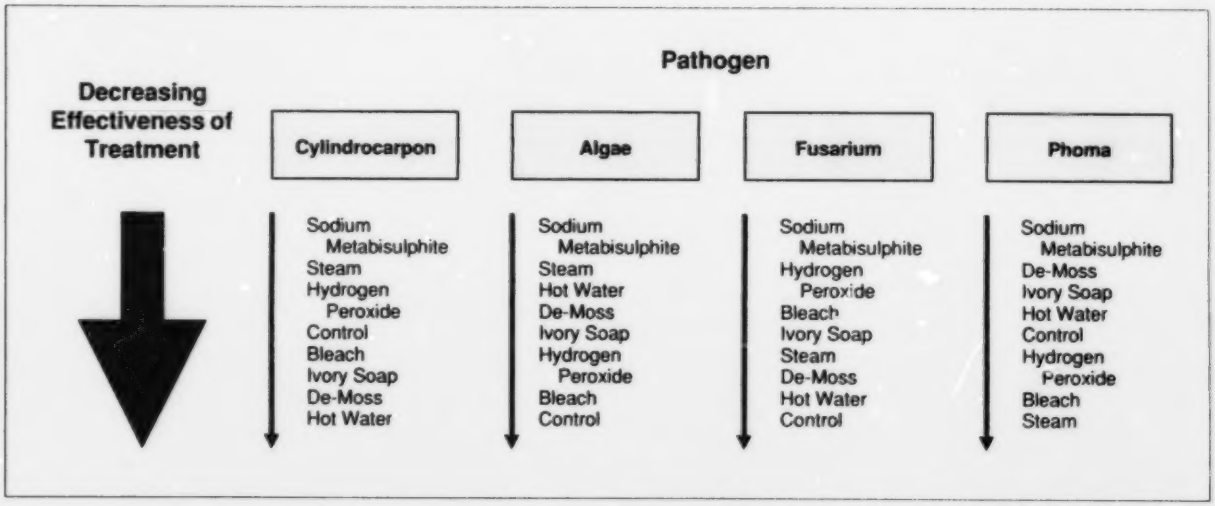
Users of this guide are advised that they do so at their own risk. Neither the Province of British Columbia, the author, nor any person who assisted in the preparation of this guide accepts responsibility for injury or damage to persons or property in any way resulting from the use of any of the methods discussed in this guide.

Summary

Algae and pathogenic fungi that can inhibit the growth of nursery seedlings are often spread from year to year through poor styroblock sanitation. Over 100 sanitation treatments were investigated as potential methods for controlling the spread of inoculum between recycled styroblocks. Seven treatments were subsequently tested and recommended for nursery use. The treatments fall into one of two categories: heat treatments (steam, hot water, heated soap) or chemical treatments (bleach, hydrogen peroxide, and sodium metabisulphite).

Sodium metabisulphite was the only one of the recommended treatments that was completely effective against all pathogens tested. Algae (all species) and Cylindrocarpon species of fungi proved to be the most difficult to control; whereas, Phoma species appeared to be the easiest. However, levels of innoculum for Phoma species were very low throughout the study, and thus the results are somewhat unreliable. The control was a high pressure water wash followed by a cold water dip at ambient temperature. In some cases, the control was equally, or more, effective than the treatment tested.

Growers must consider the history of disease at their nursery, the costs of using a new system or modifying the existing one, and the environmental and human costs that each treatment may carry. Growers can then compare the effectiveness of the treatments recommended and select a sanitizing method best suited to their needs.

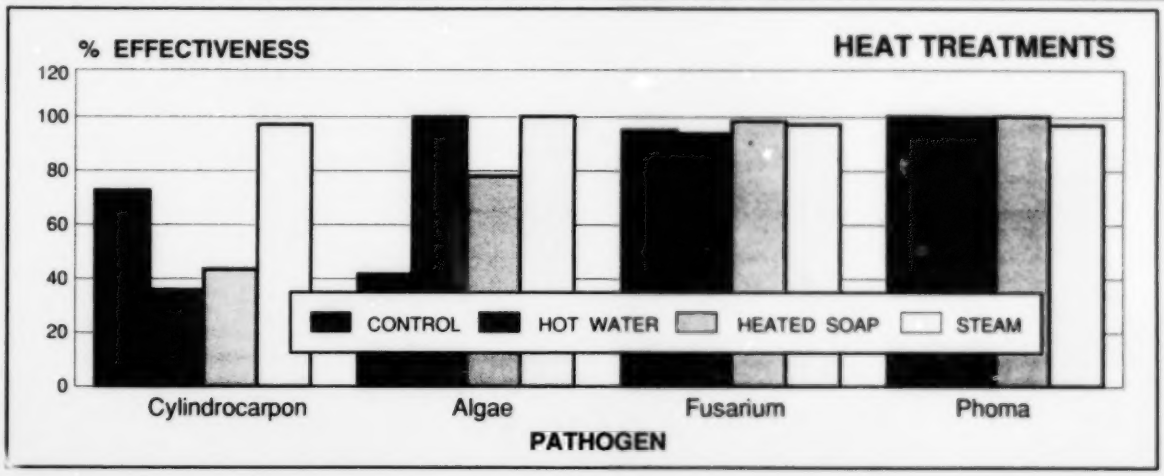


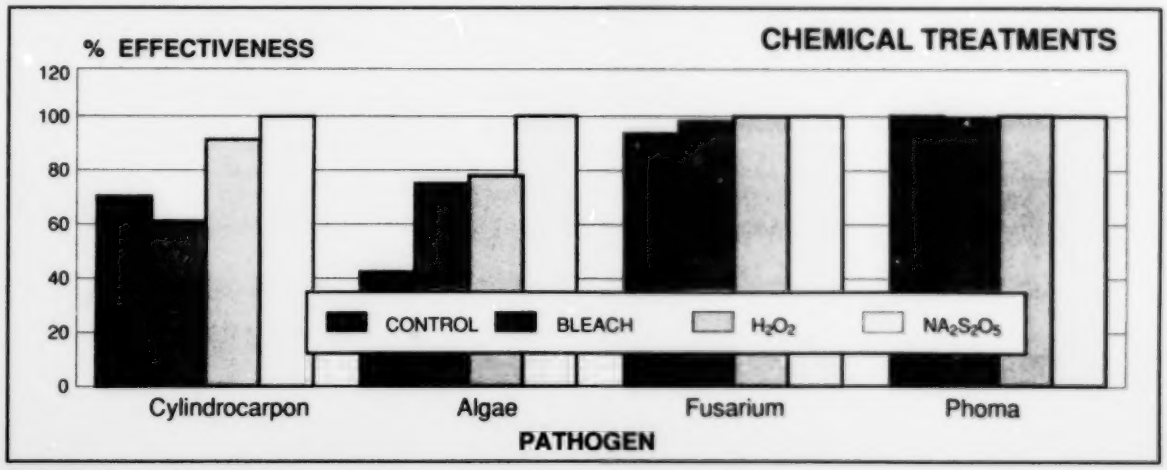
Recommended styroblock sanitation treatments in order of decreasing effectiveness.

Recommendations

Heat Treatments		Chemical Treatments	
Steam	95°C for 1 min.	**$Na_2S_2O_5$**	5% sol^n. for 10 sec.
Hot water	80°C for 10 sec.	**H_2O_5**	10% sol^n. for 10 sec.
Heated soap	5% sol^n. at 80°C for 10 sec.	**Bleach**	0.5% sol^n. for 10 sec. buffered to pH 7.0

Note: Tests with lettuce showed that none of the recommended treatments were phytotoxic to germinating seeds or seedlings. Styroblocks were loaded with peat and seeded while still wet from the dip solutions.





CONTROL = cold water

Effectiveness of Heat and Chemical treatments for the sanitation of styroblocks to control fungi and algae

Note: These results are intended for use as a guideline only. Levels of innoculum present on styroblocks will vary greatly between crops, facilities and growing years; such that the subsequent level of control by any particular treatment may vary with use.

Overview

1. Pre-treatment
A high pressure water wash set at 100psi (690kpal) at 40°C is recommended after the seedlings are lifted. This will physically remove peat, roots, liverworts and other debris before the styroblocks are dipped.

2. When to sanitize
Blocks that are sanitized following the seedling lift can gradually accumulate innoculum during the period of storage between lifting and sowing, especially during the summer months. Therefore, the optimum time to sanitize styroblocks is **just before** they are used.
If styroblocks are sanitized **immediately after** the wash, up to one liter of water can be carried over with each styroblock from the wash to the dip tank. Therefore, styroblocks should be rotated to get rid of any water in the cavities prior to entering the dip. Growers should carefully monitor the dip solution to ensure that it does not become diluted by this excess water.

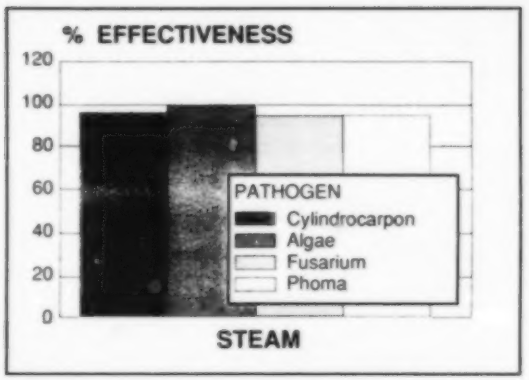
3. Treatment
Use treatments as prescribed. Unless otherwise noted, solution temperatures are maintained at ambient air temperatures.
The level of control is higher if sanitation treatments are not followed by a water rinse.

4. When to sow
Styroblocks can be sown still wet from treatment without producing any phytotoxic effects.

Heat Treatments

Steam

Steam is a very effective control against algae and fungi. Steam sanitation is best achieved if the styroblocks are treated in groups of at least 10. Problems with heat distortion may arise from high temperatures reached in the steam chamber if the steam is injected directly and too rapidly onto the styroblocks. However, a baffle, as well as a layer of old styroblocks on top of those to be sanitized, may help to reduce this problem. Another potential drawback may be the high cost of constructing a facility capable of handling large enough quantities of styroblocks.



Methods

Place styroblocks in a steam chamber leaving a 2–5 cm space between each container. Ensure that a baffle exists between the steam inlet port and the styroblocks. Seal the chamber and slowly inject steam until the chamber temperature reaches 95°C. Maintain the chamber temperature at **95°C for 1 minute.** At the end of the treatment time, release chamber pressure and remove the containers.

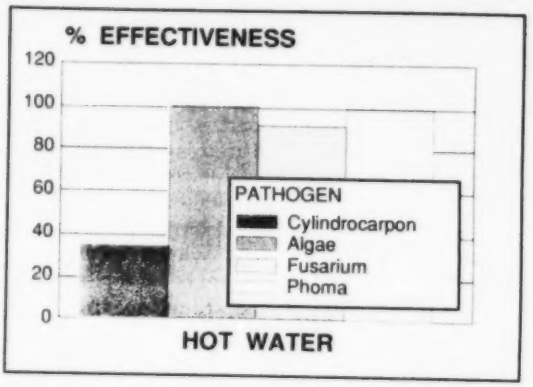
Precautions

Follow the Workers' Compensation Board of British Columbia, Industrial Health & Safety Regulation for high temperature hazards:

> 8.48 (1) "Open flames, steam pipes, steam or hot water jets and other high temperature sources shall be positioned or shielded to prevent contact by workers, unless the exposed sources are necessary to the work process."

Hot Water

Most algae and fungi cannot survive temperatures above 80°C. Thus, a hot water treatment used on its own can often result in a control that is as effective as a more complex treatment. However, in cases where two or more pathogens are contributing to the disease level in a nursery a stronger treatment may be necessary. Both ease of handling and disposal make this a desirable treatment to use whenever possible.



Methods

Heat the hot water in the dip tank to **80°C** using propane or a submersible electric heating element. After the styroblocks come out of the wash, run them through the hot water dip. Adjust the block washing line speed so that the styroblocks stay in the dip for **at least 10 seconds.**

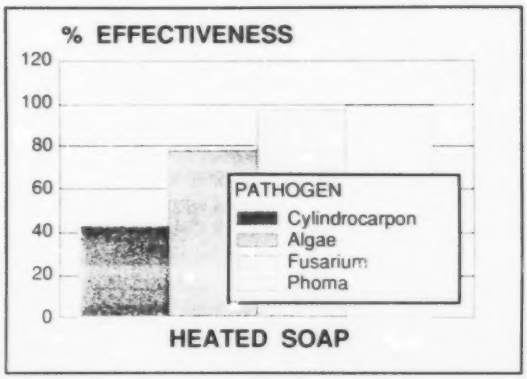
Precautions

Follow the Workers' Compensation Board of British Columbia, Industrial Health & Safety Regulation for high temperature hazards:

> 8.48 (1) "Open flames, steam pipes, steam or hot water jets and other high temperature sources shall be positioned or shielded to prevent contact by workers, unless the exposed sources are necessary to the work process."

Heated Soap

De-Moss and Ivory liquid dishwashing soap are effective styroblock sanitation treatments when heated to 80°C. Wetting agents, such as soaps, lower the surface tension of liquids and improve the penetration of the solution. In this regard, heated soap may be more effective than hot water alone. The use of soaps are advantageous as they are relatively inexpensive and easy to dispose of. Studies have shown that ivory has higher fungicidal properties than other commercial soaps tested. De-Moss is manufactured by Safer Ltd., Scarborough, Ontario.



Methods

Mix De-Moss or Ivory with water in a dip tank to achieve a **5% solution by volume (mix 1 part De-Moss/Ivory with 20 parts water).** Heat the De-Moss or Ivory solution to **80°C**. The dip solution can be heated with propane or with a submersible electric heating element. After the styroblocks come out of the wash, run them through the De-Moss or Ivory solution in the dip tank. Adjust block washing line speed so that the blocks stay in the dip for **at least 10 seconds**. To ensure the dip does not become diluted, monitor its concentration and mix new solution daily.

Precautions

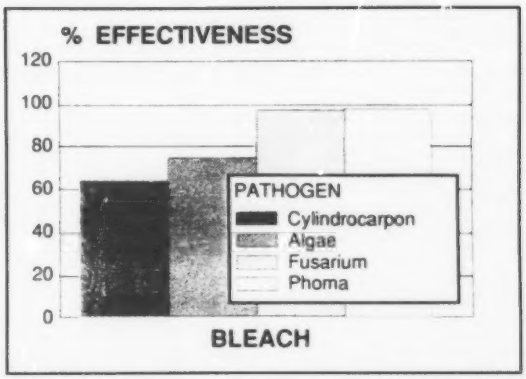
De-Moss: Causes eye irritation. Avoid eye contact. May cause skin irritation. Treated or contaminated surfaces may become temporarily slippery. This product is 30% alcohol. Store away from open flame. For a complete list of safety precautions refer to the manufacturer's Material Safety Data Sheet.
Ivory: May cause eye irritation. Avoid eye contact. Treated or contaminated surfaces may become temporarily slippery.

Disposal

Do not contaminate productive bodies of water. Dilute sufficiently with water prior to disposal to reduce foaming. Run-off of disposed De-Moss solutions will kill moss and algae in ditches.

Bleach

A 0.5% bleach solution is an effective sanitizing agent when buffered to a pH of 7.0. Either household bleach (6% available chlorine) or industrial bleach (12% available chlorine) can be used. The buffer (75% phosphoric acid, 50% sodium hydroxide) can be obtained in an easy to mix form from Advance Chemicals Ltd., Langley, B.C. A test kit for monitoring the concentration of bleach dips is also available from Advance Chemicals Ltd., Langley, British Columbia.



Methods

After the styroblocks come out of the wash, run the blocks through the **0.5% bleach solution** in the dip tank. Adjust the speed of the washing line so that the styroblocks stay in the dip for **at least 10 seconds.** To ensure the dip does not become diluted, monitor its concentration and mix a new solution daily. The pH of the dip solution can be assessed with pH paper or a pH meter. The pH should be close to 7.0

- **If the pH is above 7.0, slowly add buffer.**
- **If the pH is below 7.0, slowly add bleach.**

Using one of the concentration charts below:

Add **equal parts buffer to bleach (12%)** with the appropriate volume of water to obtain a 0.5% dip solution at the volume desired.

Final Dip Solution (litres)	Bleach - 12% (litres)	Buffer (litres)	Water (litres)
100	4	4	92
150	6	6	138
200	8	8	184
250	10	10	230
300	12	12	276
350	15	15	320
400	17	17	366
450	19	19	412
500	21	21	458

Add **one part buffer to 2 parts bleach (6%)** with the appropriate volume of water to obtain a 0.5% dip solution at the volume desired.

Final Dip Solution (litres)	Bleach - 6% (litres)	Buffer (litres)	Water (litres)
100	8	4	88
150	13	6	131
200	17	8	175
250	21	10	219
300	25	13	263
350	29	15	306
400	33	17	350
450	38	19	394
500	42	21	438

Bleach

Precautions

Inhalation of fumes or mists causes respiratory tract and mucous membrane irritation. Liquid and mists will irritate the skin or damage the eyes. Wear chemical goggles. Avoid the use of contact lenses. Wear long-sleeved shirt, trousers, rubber boots, rubber gloves and rubber apron.

The chlorine concentration in the atmosphere above the rinse tank can be monitored using a multi gas detector. The Workers' Compensation Board of British Columbia Industrial Health & Safety Regulations permissible concentration for an 8 hour exposure is 1 ppm.

For a complete list of safety precautions refer to the manufacturer's Material Safety Data Sheet.

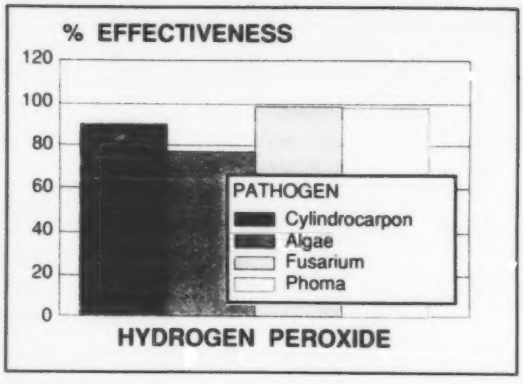
Disposal

As per the manufacturer's Material Safety Data Sheet:

> "Cautiously acidify a 3% solution or a suspension of the material to pH 2 with sulfuric acid. Gradually add a 50% excess of aqueous sodium bisulfite while stirring at room temperature. An increase in temperature indicates that a reaction is taking place. If no reaction is observed on the addition of about 10% of the sodium bisulfite solution initiate it by cautiously adding more acid. If manganese, chromium, or molybdenum are present adjust the solution pH to 7 and treat with sulfide to precipitate for burial as hazardous waste. Destroy excess sulfide, neutralize and flush the solution down the drain." Observe all federal, provincial, and local waste disposal laws and regulations.

Hydrogen Peroxide

A 10% solution of hydrogen peroxide (H_2O_2) is an effective styroblock sanitation treatment. Hydrogen peroxide has the desirable quality of rapidly breaking down into water, thereby reducing concerns over environmental contamination. However, it is extremely corrosive to all proteins and must be handled with extreme caution. One of the drawbacks to hydrogen peroxide is that it is very expensive, even though it is available as a 30% technical grade solution.



Methods

After the styroblocks come out of the wash, run them through a **10% hydrogen peroxide solution** in the dip tank. Adjust the speed of the washing line so that the styroblocks stay in the dip for **at least 10 seconds.** To ensure the dip solution does not become diluted, monitor its concentration and mix a new solution daily.

Using the concentration chart below:

Mix 30% technical grade hydrogen peroxide and the appropriate volume of water to obtain a 10% dip solution at the volume desired.

Final Dip Solution (litres)	Hydrogen Peroxide - 30% (litres)	Water (litres)
100	33	88
150	50	131
200	67	175
250	83	219
300	100	263
350	117	306
400	133	350
450	150	394
500	167	438

Precautions

Avoid contact and inhalation. Wear chemical goggles. Avoid the use of contact lenses. Wear a long sleeved shirt, trousers, rubber boots, rubber gloves and a rubber apron. Hydrogen peroxide is a CORROSIVE OXIDIZER. Keep away from chromium, manganese, silver, platinum and palladium. Keep away from organics, sodium borate, urea, sodium carbonate, sodium floride and sodium pyrophosate. Provide adequate ventilation and use a multi gas detector to monitor the air above the rinse tank. The Workers' Compensation Board of British Columbia Industrial Health & Safety Regulations permissible concentration for an 8 hour exposure is 1 ppm.

For a complete list of safety precautions refer to the manufacturer's Material Safety Data Sheet.

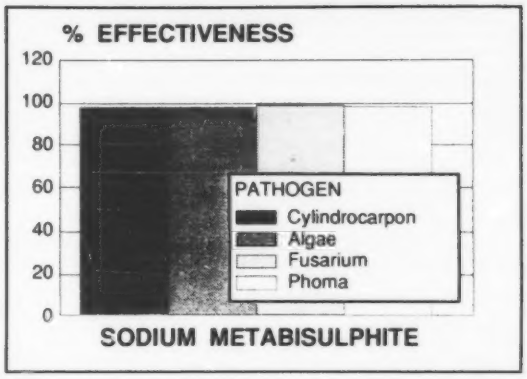
Disposal

As per the manufacturer's Material Safety Data Sheet:

> "Cautiously acidify a 3% solution or a suspension of the material to pH 2 with sulfuric acid. Gradually add a 50% excess of aqueous sodium bisulfite while stirring at room temperature. An increase in temperature indicates that a reaction is taking place. If no reaction is observed on the addition of about 10% of the sodium bisulfite solution initiate it by cautiously adding more acid. If manganese, chromium, or molybdenum are present adjust the solution pH to 7 and treat with sulfide to precipitate for burial as hazardous waste. Destroy excess sulfide, neutralize and flush the solution down the drain." Observe all federal, provincial, and local waste disposal laws and regulations.

Sodium Metabisulphite

A 5% solution of sodium metabisulphite ($Na_2S_2O_5$) is the most effective styroblock sanitizing treatment available. It is a compound commonly used in the brewing industry to stop the fermentation of naturally occurring yeasts. At low concentrations, sodium metabisulphite is safe to handle when standard pesticide handling procedures are followed. However, sodium metabisulphite is corrosive and solutions should be maintained in either stainless steel or plastic tanks. A test kit for monitoring the concentration of sodium metabisulphite dips is available from Advance Chemicals Ltd., Langley, British Columbia.



Methods

After the styroblocks come out of the wash, run them through a **5% sodium metabisulphite solution** in the dip tank. Adjust the speed of the washing line so that the styroblocks stay in the dip for **at least 10 seconds.** To ensure the dip solution does not become diluted, monitor its concentration and mix a new solution daily. When mixed with water sodium metabisulphite releases sulphur dioxide at a rate that increases with temperature. Dip treatments followed by prompt containment of the styroblocks in plastic wrap or under a tarpaulin will therefore provide additional control on the release of sulphur dioxide.

Using the concentration chart below:

Mix granular sodium metabisulphite and the appropriate volume of water to obtain a 5% dip solution at the volume desired.

Final Dip Solution (litres)	Sodium Metabisulphite (kg.)	Water (litres)
100	5.0	100
150	7.5	150
200	10.0	200
250	12.5	250
300	15.0	300
350	17.5	350
400	20.0	400
450	22.5	450
500	25.0	500

Precautions

Avoid inhalation of dust. Persons with allergies and/or asthma may exhibit hypersensitivity to sulphites. Avoid contact with eyes, skin and clothing. Wear chemical goggles. Avoid the use of contact lenses. Wear a long-sleeved shirt, trousers, rubber boots, rubber gloves and a rubber apron.

For a complete list of safety precautions refer to the manufacturer's Material Safety Data Sheet.

Disposal

As per the manufacturer's Material Safety Data Sheet:

> "For small quantities: Cautiously add to a large stirred excess of water. Adjust the pH to neutral. Separate any insoluble solids or liquids and package them for hazardous-waste disposal. Flush the aqueous solution down the drain with plenty of water. The hydrolysis and neutralization reactions may generate heat and fumes which can be controlled by the rate of addition." Observe all federal, provincial and local waste disposal laws and regulations.

For more information

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